TITLE: "Reflectance of vegetation, soil, and water"

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Objective of the Contract:

    The seasonal changes in reflectance of soils and of various crops
grown in Hidalgo County, Texas, are being studied using ERTS-1, ground,
and low to medium altitude (3,000-10,000 ft AGL) aircraft spectral data.
Discrimination of specific crop and soil conditions is being attempted;
chlorophyll content of plant leaves is being correlated with reflectance
in the visible channels, and comparisons are being made between ERTS data
and predictions from analytical models describing interaction of light
with plant canopies.

Rangeland of Hidalgo County, Texas I. Description and Remote Inventory:

    A paper is being prepared on the above subject by J. H. Everitt et al.
It will present an ecological description of the rangelands of Hidalgo County
and a discussion of their extent and distribution as determined from ERTS-1
MSS data.

    The rangelands of Hidalgo County are a component of the South Texas
Plains, but only a classical description of the three dominant range sites
(deep sand, red sandy loam, and gray sandy loam) in the county will be
presented.

The remote inventory section of the paper will map the separation of rangelands from non-rangelands in the county by using ERTS-1 MSS data.

Rangelands of Hidalgo County, Texas II. Use and Productivity:

Ground observations on rangelands, in conjunction with ERTS-1 investigations, have been incorporated in a manuscript prepared on the above subject. The abstract follows:

"Data on predominant animal grazing the range, grazing pattern used, stocking rates, brush control practices, potential productivity, and forage species seeded to the range were obtained by owner-operator interviews, field observations, and Soil Conservation Service sources on a sampling of 41 management units in Hidalgo County, Texas, totaling 8,473 acres. The data permitted a compilation of management practices and uses representative of the 350,000 acres of range in the study county. The range is used primarily for cow-calf operations, although wildlife management is an important consideration and source of income. Continuous year-long grazing was practiced on 18 management units (63% of acreage) and some type of deferred system was in use on 23 units (37% of acreage). Brush control was practiced on 47% of the sampled acreage; mechanical brush control was practiced on 35% and chemical control on 12%. Buffelgrass was seeded to 21% of the total acreage. Little fertilizer is used. The information presented documents typical range management practices and uses for this segment of the South Texas Plains and permits analysis of alternative practices."

Acreage of Vegetables in Hidalgo County in 1972 and 1973:

Ground surveys made in conjunction with the ERTS-1 project provided data for a manuscript prepared on the above subject. The abstract follows:

"Ground surveys from the fall of 1972 through the spring of 1974 on approximately 1400 fields in Hidalgo County provided a replicated sample that permitted calculation of county acreage estimates, and standard errors of the estimate, for 18 vegetable crops produced in the county.

"Acreage estimates not previously available are tabulated for 7 crops (bean, beet, mustard greens, turnip, parsley, peas, and squash) along with comparative acreages for 9 others (broccoli, cabbage, carrot, cantaloupe, cucumber, lettuce, onion, green pepper, and tomato) that are estimated by the Texas Crop and Livestock Reporting Service (TCLRS). The ground survey consistently overestimated the acreage of onion and tomato compared with the TCLRS estimates, and the ground survey inadequately sampled the melon and potato areas of the northern and western part of the county; however, it appears to yield representative estimates for about 15 vegetable crops. Since the acreage of citrus, cotton, grain sorghum and other commodities can be obtained from the same survey that yields vegetable acreages, there is merit in the various commodities jointly sponsoring such a survey; one in April for the warm season crops and one in December for the fall-planted crops would suffice."

Citrus Acreage of Hidalgo County by Varieties and Tree Age Groups:

In conjunction with ground truth for the ERTS-1 project, a paper has been prepared on the above subject. The abstract follows:

"Ground surveys and Earth Resource Technology Satellite digital data were used to estimate the acreage of citrus in Hidalgo County, Texas, as of January 1973. The acreage estimates from these two sources were 89,000 acres and 81,000 acres, respectively. Interviews with the managers or owners of 119 plantings were also conducted to obtain information on the acreage of citrus by early and midseason orange, late orange, and grapefruit categories and the age of the trees by 0-3, 4-7, and 8 or older age groups. The interviews resulted in estimated acreages of 19,400 acres of early and midseason (Marrs, Hamlin, Pineapple, Jaffa, Navel) oranges; 19,000 acres of late orange (Valencia), and 46,600 acres of grapefruit (ruby red, star ruby, Marsh pink, and white). Grouping the plantings by age, the ruby red grapefruit has been the overwhelming choice for recent plantings. None of the early orange varieties is popular, as indicated by no plantings in the 0-3 year old group, although Marrs oranges appeared popular several years ago as indicated by the number of groves in the 4-7 year old group. Grapefruit plantings appear to be continuing at the 4,000 to 5,000 acre per year rate. The findings should be of value to the citrus industry for projecting nursery tree demand, and for planning harvesting and marketing operations."

Models for Extracting Shadows:

A paper entitled "Models for Extracting Plant, Soil, and Shadow Reflectance Components of Row Crops" has been prepared by A. J. Richardson et al. The abstract follows:

"This study was conducted to investigate three plant canopy models (Kubelka Munk (K-M), regression, and combined models) for extracting the plant, soil, and shadow components from the spectra of vegetated surfaces. Earth Resource Technology Satellite (ERTS-1) data collected on May 27, 1973, were the test data used. Soil and shadow between plant rows decreased the reflectance (reflective infrared region) of immature cotton (49.1 and 53.1 percent) compared with the reflectance of mature corn and sorghum (63.1 and 96.6 percent).

"The regression model correlation of composite canopy reflectance to ground truth improved from 0.157 to 0.749** without a shadow term (soil term only) to 0.201 to 0.833** with a shadow term. The combined model yielded higher correlations (R = 0.717** to 0.949**) in general than the K-M (R = 0.433 to 0.915**) or regression (R = 0.201 to 0.833**) models. Reflectance values for plant canopy, soil, and shadow areas seem more reasonable for the combined model than for the K-M or regression models because the reflectance contributions of plants grown on a soil background and edge effects due to soil and shadow between plant rows were better accounted for."

Significant Results and Practical Applications:

The majority of the rangelands of Hidalgo County, Texas are used in cow-calf operations. Continuous year-long grazing is practiced on about 60% of the acreage and some type of deferred system on the rest. Mechanical brush control is used more than chemical control. Ground surveys gave representative estimates for 15 vegetable crops produced in Hidalgo County. ERTS-1 data were used to estimate the acreage of citrus in Hidalgo County.

Combined Kubelka Munk and regression models, that included a term for shadow areas, gave a higher correlation of composite canopy reflectance with ground truth than either model alone.

Publications:

Cuellar, J. A., A. H. Gerbermann, and C. L. Wiegand. Citrus acreage of
Hidalgo County by varieties and tree age groups. J. Rio Grande
Valley Hort. Soc. (In review).

Everitt, J. H., J. A. Cuellar, C. L. Wiegand, and D. G. Akers. Rangelands
of Hidalgo County, Texas II. Use and productivity. J. Range
Management (In review).

Gerbermann, A. H., C. L. Wiegand, and J. A. Cuellar. Acreage of vegetables
in Hidalgo County in 1972 and 1973. J. Rio Grande Valley Hort. Soc.
(In review).

Leamer, R. W., and A. H. Gerbermann. Field size distribution and land use
in Hidalgo County, Texas. J. Rio Grande Valley Hort. Soc. (In review).

Richardson, A. J., C. L. Wiegand, H. W. Gausman, J. A. Cuellar, and A. H.
Gerbermann. Models for extracting plant, soil, and shadow reflectance
components of row crops. Agron. J. (In review).

Recommendations Concerning Changes in Operations, Additional Investigations,
Efforts and Effort/Results as Related to the ERTS System:

A more complete investigation is needed on effects of dry and green
biomasses on ERTS MSS digital counts.

Changes in Standard Order Forms:

None.

ERTS Image Descriptor Form:

Attached.

Changes in Retrospective Data Requests:

None.

Planned Work for the Next Reporting Period:

Continue processing manuscripts that are in review stages.

Do further work on comparing predicted and measured leaf area indexes.

Begin formulating a Type III Report.